Not to be cited without
permission of the authors[1]

DFO Atlantic Fisheries
Research Document 96/43

Ne pas citer sans
autorisation des auteurs[1]

MPO Pêches de l'Atlantique
Document de recherche 96/43

STATUS OF ATLANTIC SALMON IN THE BOUCTOUCHE RIVER IN 1995

by

G. Atkinson and G. Chaput

Department of Fisheries & Oceans
Science Branch, Gulf Region
P.O. Box 5030
Moncton, New Brunswick, E1C 9B6

[1]This series documents the scientific basis for the evaluation of fisheries resources in Atlantic Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

Research documents are produced in the official language in which they are provided to the secretariat.

[1]La présente série documente les bases scientifiques des évaluations des ressources halieutiques sur la côte Atlantique du Canada. Elle traite des problèmes courants selon les échéanciers dictés. Les documents qu'elle contient ne doivent pas être considérés comme des énoncés définitifs sur les sujets traités, mais plutôt comme des rapports d'étape sur les études en cours.

Les documents de recherche sont publiés dans la langue officielle utilisée dans le manuscrit envoyé au secrétariat.

TABLE OF CONTENTS

Page

Abstract 3

Resumé 4

Summary Sheet 5

Introduction 6

Description of Fisheries 6

Target 9

Research Data 9

Estimation of Stock Parameters 12

Assessment Results 13

Ecological Considerations 15

Forecast/Prospects 16

Management Considerations 16

Research Recommendations 16

Acknowledgements 17

Literature Cited 18

Tables 19

Figures 24

Appendices 33

ABSTRACT

Angling effort on the Bouctouche River is low and in most years insufficient to estimate catches: estimates by the New Brunswick Department of Natural Resources for 1995 were not available at the time of publication. A telephone survey of anglers indicated that at least 8 small salmon were retained. First Nation catches were 15 small salmon. Unrecorded catch (poaching) was estimated at 26 large and 24 small salmon. A mark-recapture experiment was the basis for estimating returns: tags were applied at two estuary trapnets and recovered at the upper trapnet and a counting fence in freshwater, providing two independent estimates. From estuary recaptures large salmon total returns were estimated at 108 and small salmon total returns at 83. Respective spawning escapements were 101 and 52. Total egg deposition was 40% of target. From recaptures in freshwater large salmon total returns were estimated at 154 and small salmon total returns at 98. Respective spawning escapements were 147 and 67. Total egg deposition was 58% of target. These results represent a decline of 14% to 32% in egg target met, relative to 1994. As in 1994, juvenile densities at the sites surveyed were well below optimum, confirming that spawning in recent years has been inadequate. At present, sufficient information on stock status has not been accumulated to forecast returns, but with three consecutive years well below target spawning it is unlikely that target will be met on the Bouctouche River in 1996, or that there will be a harvestable surplus.

RÉSUMÉ

Dans la rivière Bouctouche, l'effort de pêche sportive est faible et ne permet pas, la plupart des années, une estimation des prises : les estimations du ministère des Ressources naturelles du Nouveau-Brunswick n'étaient pas disponibles au moment d'aller sous presse. Une enquête téléphonique auprès des pêcheurs a révélé que ces derniers avaient conservé au moins 8 petits saumons. Les Autochtones ont capturé 15 petits saumons. Les prises non consignées (braconnage) ont été estimées à 26 gros saumons et 24 petits saumons. La remonte a été estimée par marquage et recapture : des étiquettes ont été fixées aux poissons dans deux filets-trappe disposés dans l'estuaire, puis récupérées au filet-trappe amont et à une barrière de dénombrement située en eau douce, de manière à obtenir deux estimations indépendantes. La recapture en estuaire a permis d'estimer la remonte totale à 108 gros saumons et 83 petits saumons, le nombre de sujets atteignant les frayères à 101 et 52 respectivement et la ponte totale à 40 % du niveau cible, tandis que la recapture en eau douce a permis d'estimer la remonte totale à 154 gros saumons et 98 petits saumons, le nombre des sujets atteignant les frayères à 147 et 67 respectivement et la ponte totale à 58 % du niveau cible. Par rapport à 1994, ces résultats constituent une diminution de 14 à 32 % du taux d'atteinte des objectifs de ponte. Comme en 1994, la densité des juvéniles dans les stations étudiées était bien en deçà de la valeur optimale, ce qui confirme l'insuffisance de la fraye ces dernières années. Nous n'avons pas encore accumulé assez de données sur l'état des stocks pour pouvoir prédire la remonte; cependant, étant donné les trois années successives de fraye très inférieure à l'objectif, il est peu probable que cet objectif soit atteint en 1996 dans la rivière Bouctouche ou qu'il y ait un surplus exploitable.

SUMMARY SHEET

STOCK: Bouctouche River (SFA 16)
TARGET: 1.587 million eggs (281 large salmon, 172 small salmon)[1]

	1990	1991	1992	1993	1994	1995	MIN[2]	MAX[2]	MEAN[2]
Angling catch									
Large (Released)	47			35	20	na	20	52	
Small (Rel + Kept)	16			64	7	na(8)	7	64	
First People's Harvest									
Large			12	0	12	0			
Small			0	0	11	15			
Broodstock removals									
Large						7			
Small						8			
Spawning escapement[3]									
Large				94	212	147			
Small				21	59	67			
Total returns[3]									
Large				95	225	154			
Small				78	77	98			
% Egg Target met[3]									
Large				34	72	55			
All spawners				35	72	58			

[1] The egg target remains unchanged; target spawners have been adjusted to reflect average stock characteristics observed from 1993-95.

[2] Angling catch min, max are for years 1984 to 1994; the mean was not calculated because angling catches are not estimated on a consistent basis.

[3] Spawning escapement, total returns, and percent target met for 1995 are the higher of two estimates. To make comparison more valid, the 1993 and 1994 assessment results have been recalculated using the methodology described in the current report.

Recreational catches: Catch statistics from the New Brunswick Department of Natural Resources and Energy were not available at the time of publication. A telephone survey indicated that a minimum of 8 small salmon were retained.

Data and assessment: Returns of large and small salmon to the Bouctouche River were estimated from tags applied at two estuary trapnets and recaptured at the upper trapnet and a counting fence. Spawners were estimated as returns minus known and estimated removals.

State of the stock: Spawning escapement was not met for large or small salmon in 1995. Total egg deposition was estimated at 40% to 58% of target.

Forecast for 1996: Because 1995 is only the third year of data on returns, no quantitative forecast can be made for 1996. However, given three consecutive years with well below target escapement, it is unlikely that the target will be met in 1996.

Management Considerations: There will probably not be a harvestable surplus of salmon from the Bouctouche River in 1996.

Introduction

The Bouctouche River is situated in Kent County, New Brunswick and flows in an easterly direction to Northumberland Strait in Statistical District 77, Salmon Fishing Area 16 (Figs.1,2). The system is small and has no man-made barriers to ascending fish. A spawning run of Atlantic salmon, composed of approximately two thirds multi-seawinter fish, enters the river during September and October. The resource is exploited for food by Buctouche First Nation and for public recreational angling. Information on stock status is required to manage salmon harvest on the Bouctouche, ensuring that adequate spawning escapement occurs on a sustainable basis. This is of particular concern on smaller rivers where the potential to overexploit remaining wild stocks is high.

The stock on this river has been assessed twice previously, in 1993 and 1994 (Atkinson and Claytor MS1994, Atkinson *et al.* MS1995). Under the Aboriginal Fisheries Strategy (AFS) agreements the Department of Fisheries and Oceans (DFO) provides funding and training to First Nations in the interest of developing a co-management approach to the resource. These assessments were accomplished through mark-recapture experiments in which tags were applied in the estuary at Buctouche First Nation trapnets and recovered in the recreational fishery or a counting fence upriver. In 1995, tags were again applied in the estuary at First Nation trapnets. Recaptures were obtained from the upriver estuary trap, from a counting fence in the freshwater portion of the river operated by the Southeast Anglers Association, and from anglers.

Results of electroseining at three sites during the summer of 1995 were provided by the Southeast Anglers Association.

Description of Fisheries

Commercial

Commercial harvesting of Atlantic salmon ceased in 1984. The harvest from 1967 to 1983 in SFA 16 was presented in Atkinson and Claytor (MS1994).

First Nation

Buctouche First Nation currently harvests salmon from research trapnets in the Bouctouche River during September and October. Prior to 1992, this was a sporadic gillnet fishery and numbers taken were not recorded. In 1992, 12 large (63 cm or more) salmon were taken. No fish were harvested in 1993 as a conservation measure due to low returns, and in 1994 a total of 12 large and 11 small (less than 63 cm) salmon were harvested. In 1995, 15 small salmon were removed for food. Allocations to Buctouche First Nation under the AFS agreement in 1995 were 36 large and 56 small salmon.

Recreational

Recreational angling occurs upstream from the head of tide. There is no leased water on the system. Black salmon are angled from April 15 to May 15, bright salmon from June 8 to October 31. The bright season was extended in 1993 from October 15 to the end of the month. Almost all angling for bright salmon occurs from late September to the end of the season. Prior to 1984 all salmon could be retained. In 1984 large black salmon could be kept but all large bright salmon had to be released. Beginning in 1985, regulations have required all large salmon (brights and blacks) to be released, and only small salmon could be retained. In 1992, the season limit for small salmon was reduced from ten to eight, and this regulation remains in effect.

Recreational catches up to 1993 were estimated by the New Brunswick Department of Natural Resources and Energy (DNRE) based on a random survey representing 20 percent of license purchasers. In the case of the Bouctouche River, the rate of survey return was often not high enough to estimate catch accurately (Table 1). In 1994 DNRE surveyed 42 percent of license holders to improve the accuracy of catch estimates, particularly for small rivers such as the Bouctouche. Data were not available for 1995 at the time of publication.

A telephone survey was therefore conducted of 27 anglers known to fish the Bouctouche River. The list was compiled from personal contact on the river, from names provided by local angling associations, and from anglers who have returned tags. Only 15 anglers on the list fished the Bouctouche in 1995 and of

these, only 6 caught salmon. Results indicated that 8 small salmon were retained and 2 were released: no large salmon were caught and released. It is not known what proportion of all angling the survey represented.

Other

Estimates of unrecorded catch are obtained from fishery officers (DFO, DNRE, First Nation) and represent known or suspected removals in the estuary or freshwater due to by-catch in other gear or poaching. A survey of by-catch in the Bouctouche estuary from gaspareau traps (June), and smelt traps (November), conducted by the Southeast Anglers Association found no incidence of salmon on the few dates when gear was checked. However, it was suggested by DFO fishery officers that 6 large and 24 small salmon could have been taken late in the season as by-catch in the estuary smelt traps. Poaching in the freshwater portion of the river is considered to be a problem. Although no apprehensions or seizures of gear were made by fishery officers, DNRE wardens suggested that 20 large salmon could have been taken.

An enhancement initiative for the Bouctouche River, under the auspices of DFO and the Southeast Anglers Association, resulted in the removal of 7 large and 8 small salmon for broodstock. These fish were returned to the river following artificial spawning at the DFO Miramichi hatchery. The progeny of these fish will be stocked in the Bouctouche as fall fingerlings in 1996.

Summary of Removals, 1995

Location	Large	Small
First Nation Food (traps)	0	15
Angling (freshwater)	0	8
Unrecorded (estuary)	6	24
Unrecorded (freshwater)	20	0
Broodstock (counting fence)	7	8
Total	33	55

Target

The calculation of the egg target and required number of spawners for the Bouctouche River is detailed in Table 2, using Method 2 recommended by Randall (MS1985) for the Miramichi River. The number of spawners needed to meet egg deposition requirements was calculated assuming all egg deposition came from large salmon. The number of small salmon required was calculated assuming that at least one male spawner was needed for each female large salmon. Fecundity was considered to be equivalent to Miramichi stock, based on river proximity. Also, the Bouctouche was stocked in 1978-79 with 37,000 juvenile salmon from the Miramichi River (Newbould 1983). Stock characteristics used were the means of values observed from 1993-95. Sex determination was done using external characters, with sex ratios derived accordingly. The 2SW component of total large salmon requirements was calculated using the mean proportion from aged samples (1992-94).

Egg Target: 1.587 million eggs
Large Spawners: 281 (2SW component: 244)
Small Spawners: 172

Research Data

Mark/Recapture

In co-operation with Buctouche First Nation, two trapnets were operated in the tidal portion of the river to mark and recapture salmon. The lower (mark trap) was situated 3 km upriver (west) of the Route 11 bridge in Bouctouche, the upper (recapture trap) was located approximately two km upstream from this point (Fig.3). The box portion of the traps measured 3.7 m (12') wide by 18.3 m (60') long and was constructed with 5.7 cm (2.25") mesh knotless nylon. A single leader of approximately 60 m (200'), extending from shore into a door in the middle of the long side of the box, was made from 11.4 cm (5.5') mesh polypropylene. The traps were configured to fish one way (upstream). Salmon caught in both traps were measured for fork length, sexed using external characters, scale sampled, marked with small blue Carlin tags attached with a single wire through the back behind the first ray of the dorsal fin, and released.

The lower trap was operated from September 18 to October 29, and the upper from September 22 to October 29; the first salmon was caught on September 18, the last on October 25. Captures of both large and small salmon peaked between October 4 and 7 (Week 40). This timing was approximately three weeks earlier than 1994 for large and one week earlier for small salmon. Total catch for both traps was 46 large and 52 small salmon, exclusive of recaptures (Table 3, Fig.4). Relative to 1994, catch in the mark trap declined by 71% for large salmon and increased by 31% for small. Recapture trap figures are not comparable because the trap only fished for 5 days in 1994.

A counting fence was installed on the main stem of the river 2.75 km upstream from the head of tide, just below the confluence of the South Branch (Fig.3). The fence, consisting of a trapnet about 6m (20') long by 3m (9') wide and connected to the shore by two downstream-angled leaders, trapped fish moving upstream only. The trap and leaders were constructed with 5.7 cm (2.25") knotless nylon mesh, held in place with steel rods driven into the stream bed. The fence was operated from October 11 to November 10 by members of the Southeast Anglers Association. Each fish was measured, sexed and a scale sample was taken for ageing. All untagged fish released upstream were marked by punching a 5mm (1/4') hole in the caudal fin. Water conditions had been extremely low until three days prior to fence installation, when a slight raise in level brought fish up; several were observed in the pool immediately above the fence location prior to installation. Salmon were caught at the fence immediately after installation and up to November 3. However, due to heavy rain and high water conditions the facility was washed out or only partially operating from October 29 on. Hence, a total count of fish ascending past the site was not possible for 1995. Peak catches occurred during Week 43, with totals of only 10 large and 27 small salmon (Table 4, Fig.5).

Tags were recovered at the recapture trap, the counting fence and from angling captures above the fence. Tagging effort and recaptures in 1995 are as follows:

Tags Applied

Location	Large	Small
Marking trap	11	15
Recapture trap	35	22
Total	46	37

Tags Recaptured

	Large		Small	
Location	Recap	Catch	Recap	Catch
Recapture trap	4	39	8	43
Counting fence	3	10	12	27
Angling	0	0	7	10

Biological Characteristics

A length-frequency histogram for all salmon caught at counting facilities on the Bouctouche River for 1995 is presented in Figure 6. The mean length of large salmon was 79.2 cm; 79% were females and 21% males. Mean length of small salmon was 55.6 cm; 17% were females and 83% males. The large salmon proportion of the catch in 1995 as determined from the recapture trap sample was 50%. The 1995 sample has not yet been aged. Of known-age fish in 1994, 2, 3, and 4 year smolts respectively comprised 62%, 37% and 1% of the sample. Of the multi-seawinter (MSW) component, 78% were maiden two-seawinter (2SW) fish and 22% were repeat spawners. Repeat spawning one-seawinter (1SW) fish, or grilse, represented 5% of all MSW fish and 23% of all repeat spawners(Table 5).

Electroseining

In August of 1995 members of the Southeast Anglers Association electroseined at three locations on the Bouctouche to determine densities and percent habitat saturation (PHS) of juvenile salmonids. Two of these locations (sites 1, 2) were on the main stem of the river below the confluence with the South

Branch and the other (site 5) was on the South Branch (Fig.3). These essentially corresponded to sites sampled in 1994. Sites were unbarriered, and the successive removal method (4 sweeps) was used. The data were analysed using the Zippin procedure (1958), and PHS values were calculated according to Grant and Kramer (1990). A PHS value around 27 is considered a useful reference point; above this a greater than 50% chance exists that a density dependent response will occur. At the South Branch site, low densities of 1+ and 2+ parr were found, where none occurred in 1994. This may simply reflect improved conditions at the site over the previous year. The lack of 0+ parr suggests that either spawning success in 1994 or juvenile survival was not high in this branch. At the main stem sites the riffle and run areas were found to contain low densities of 1+ juveniles where none were found previously, indicating somewhat improved spawning or survival in 1994 over previous years. As in 1994, low densities of 1+ and 2+ parr were seen in the riffle habitat (Table 6). Densities and PHS values for all juveniles at all sites were very low. With so few sites sampled, it is difficult to say anything definitive about juvenile densities, but the results do suggest that spawning success and/or juvenile survival is low, at least in the upper South Branch and lower main stem areas. Brook trout were also found at low densities in the main stem sites; none were caught in the South Branch.

Estimation of Stock Parameters

Returns were calculated in two ways: 1) from tags placed at the lower estuary trap and recovered at the upper; and 2) from all tags placed at estuary traps and recovered at the counting fence using a Bayesian estimator as described by Gazey and Staley (1986). The most probable population size given R recaptures out of M marks placed in a sampled catch of C was calculated over a range of possible population sizes. Only tags applied in the current year or those from previous years which were seen at the trap(s), were used. These are the totals indicated in the tagging summary above. A tag loss rate was not factored into the calculations because it was thought to be negligible over the short period (one month) during which tags were recaptured.

Total returns to the system were obtained by adding removals known to have occurred prior to marking. The corresponding

spawning escapement was then computed by subtracting total known removals from total returns. Known removals were First Nation harvest, angling catch and broodstock, as detailed above. Because estimates of unrecorded catch (poaching) are unsubstantiated, those alleged to have occurred in the estuary have not been included in the estimates of total returns. The egg deposition rate (2.4 m^{-2}) used to calculate the target compensates for in-river losses to poaching and disease. Consequently, in-river poaching estimates have not been subtracted from total returns to calculate spawning escapement.

Assessment Results

Total Returns and Spawning Escapement - 1995

1. The estimate of total returns to the river based on tag recaptures at the upper estuary trap is 108 for large salmon and 83 for small salmon, with respective spawning escapements of 101 (95% CI: 53-483)and 52 (95% CI: 23-181). The probability of achieving target escapements was only 15% for large and 3% for small salmon (Figs.7,8).

2. The estimate of total returns to the river based on tag recaptures at the counting fence is 154 for large salmon and 98 for small salmon, with respective spawning escapements of 147 (95% CI: 85-583) and 67 (95% CI: 45-141). The probability of achieving target escapements was only 35% for large and 0.6% for small salmon (Figs.9,10).

The variation between the two estimates is principally due to the relatively low numbers of marks placed and recovered. Based on fecundity values derived from stock characteristics observed in 1995 (5931 eggs/large salmon, 607 eggs/small salmon), total egg deposition was estimated at 40% (estimate 1) to 58% (estimate 2) of target for the system, assuming that all fish spawned. Thus, target spawning was not achieved on the Bouctouche River in 1995.

Review of 1993 and 1994 assessments

As techniques of assessment evolve and improve, the results from previous years may not be directly comparable to those from current assessments. To better compare the state of the Bouctouche River salmon stock over the years 1993-95, the former assessments (Atkinson and Claytor, MS1994; Atkinson *et al.*, MS1995), have been recalculated as detailed therein, making the changes noted below to standardise results.

1. A tag loss rate was not used in 1993.
2. Angling removals were based on updated statistics provided by DNRE.
3. Estimates of unrecorded catch were not used to calculate total returns or spawning escapement.
4. Percent of target met was calculated with respect to the current egg target, using fecundities derived from stock characteristics observed in the year of assessment.

1993: Total returns of large salmon were estimated at 95 and small salmon at 78, with respective spawning escapements of 94 and 21. Presuming all fish spawned, only 35% of the egg target was met. Previously, this estimate was 14%.

1994: Total returns of large salmon were estimated at 225 and small salmon at 77, with respective spawning escapements of 212 and 59. Presuming all fish spawned, 72% of the egg target was met. The former estimate was 61%.

The results of these recalculations replace the former values in the summary sheet at the beginning of this document. Although the Bouctouche salmon stock may not be quite as depressed as formerly thought, spawning has still been well below target for the past three years.

Sources of uncertainty

The spawning target for the Bouctouche River may be unrealistically high in terms of the proportion of total habitat accessible to spawning salmon. Juvenile density data are scant, but suggest that the upper reaches of some tributary streams may be inaccessible or inadequate for rearing. In this assessment it has been assumed that all spawning occurred in the Bouctouche

River. However, several smaller unsurveyed streams flow into the estuary which may have spawning potential for salmon. More extensive electrofishing in the entire system would determine the extent of habitat use.

In calculating the percent of egg target met, the accepted expedient of assuming that all the estimated spawning escapement did in fact spawn, should be examined. If the calculated sex ratio is severely imbalanced, the assumption may not be warranted. In the current assessment the calculated female:male ratio is 1:0.7.

Fecundity values used to derive target spawners from target egg deposition have been assumed from similar stock (Miramichi), rather than determined by direct measurement. This information could be obtained directly from food fish removed from assessment trapnets by the First Nation crews operating them, if harvesting continues. Some preliminary data will be available from broodstock collected in 1995.

The validity of applying 2.4 eggs/sq. m as an optimum deposition to all rivers is constantly challenged. Ways to refine this for individual rivers need to be sought.

Although expanded surveys by DNRE may improve angling catch statistics for smaller rivers such as the Bouctouche, collation of data is not done in time to incorporate them into the assessments. A telephone survey provided a minimum estimate, but a co-operative logbook or survey program with the Southeast Anglers Association could provide better and more timely information.

Poaching is considered to be a serious problem on this river by DNRE conservation officers; less so by DFO fishery officers. Documentation is poor since apprehensions are few, but these unvalidated estimates can be a significant proportion of total returns - 16% to 26% of large salmon in the current year (50% in 1993; 20% in 1994).

Ecological Considerations

Water flows in the Bouctouche River were low until October 10. Fish concentrated at the head of tide but few ascended further until after this time. Persistent rain with accompanying high

water levels prevailed well into November. This caused difficulty maintaining the counting fence and a total count of salmon for the duration of its operation was not possible. Angling conditions were reportedly poor, but better than in 1994. Seven tags from small salmon were returned, compared to none the previous year. High water for an extended period was probably beneficial to spawners, allowing them better access to upriver spawning sites than in 1994, and potentially deterring poaching efforts.

Forecast/Prospects

At present there is no reliable method of forecasting returns of Atlantic salmon to the Bouctouche River. It may be possible to develop in-season forecasting using run-timing to the trapnets when a sufficient number of years of trapnet operation have accumulated. Given a longer term data set, it may be possible to develop a stock/recruit relationship. However, given three consecutive years with well below target spawning escapement, it is unlikely that the target will be met in 1996.

Management Considerations

There will probably not be a harvestable surplus of salmon from the Bouctouche River in 1996.

Research Recommendations

1. Operate at least one marking trap in the estuary, in conjunction with a counting fence upriver. If the fence cannot be maintained, both estuary traps should continue to be operated.

2. Extend the electroseining survey to determine the extent of habitat use in the main river and other small streams emptying into the estuary, and obtain juvenile densities to help validate spawning success.

3. It is not clear whether the constraint on juvenile abundance is habitat or spawning success. Perhaps the stocking of marked fall fingerlings will address this question to some extent by examining seasonal survival rates.

4. Obtain direct measurements of fecundity from First Nation food fishery and/or broodstock collections, to establish more accurate stock-specific spawning targets.

5. Establish a logbook or survey program with the Southeast Anglers Association, to obtain better and more timely angling data.

Acknowledgements

We thank Buctouche First Nation for operating the estuary trapnets and collecting relevant data, members of the Southeast Anglers Association for operating the counting fence and providing electroseining and by-catch data, and participants in the Bouctouche Salmon Science Workshop for their input and suggestions (Appendix 1).

Literature Cited

Atkinson, G. and R.R. Claytor. MS1994. Status of Atlantic salmon in the Buctouche River in 1993. DFO Atlantic Fisheries Research Document 94/15.

Atkinson, G. Pettigrew, T., LeBlanc, J., and G. Cormier. MS1995. Status of Atlantic salmon in the Bouctouche River in 1994. DFO Atlantic Fisheries Research Document 95/14.

CAFSAC. MS1991. Quantification of conservation for Atlantic salmon. CAFSAC Adv. Doc. 91/16.

Gazey, W.J., and M.J. Staley. 1986. Population estimation from mark-recapture experiments using a sequential Bayes algorithm. Ecology 67: 941-951.

Grant, J.W.A., and D.L. Kramer. 1990. Territory size as a predictor of the Upper limit to population density of juvenile salmonids in streams. Can. J. Fish. Aquat. Sci. 47: 1724-1737.

Newbould, K.A. 1983. Hatchery salmonid production and distribution (1976-82), Nova Scotia, New Brunswick and Prince Edward Island. Can. Data Rep. Fish. Aquat. Sci. 410: ix + 260p.

Randall, R.G. MS1985. Spawning potential and spawning requirements of Atlantic salmon in the Miramichi River, New Brunswick. CAFSAC Res. Doc. 85/68.

Zippin, C. 1958. The removal method of population estimation. J. Wildl. Man. 22(1): 82-90.

Table 1. Atlantic salmon angling catch on the Bouctouche River, 1984 - 1995. Estimates provided by New Brunswick Department of Natural Resources and Energy. Small salmon numbers up to 1993 include released fish. Dashes (-) indicate insufficient data to calculate; 1995 data not available (na).

Black Salmon

Year	Small Kept	Small Rel	Large Rel	Total	% Large	Rods	CPUE
1984	-		-	-	-	-	-
1985	-		-	-	-	-	-
1986	-		-	-	-	-	-
1987	-		-	-	-	-	-
1988	-		-	-	-	-	-
1989	-		-	-	-	-	-
1990	-		-	-	-	-	-
1991	-		-	-	-	-	-
1992	-		-	-	-	-	-
1993	-		-	-	-	0	-
1994	0		0	0	0	7	0
1995	na	na	na	na	na	na	na
Mean,90-94	-	-	-	-	-	-	-
95+/- Mean	-	-	-	-	-	-	-

Bright Salmon

Year	Small Kept	Small Rel	Large Rel	Total	% Large	Rods	CPUE
1984	13		-	13	-	13	1.000
1985	-		-	-	-	-	-
1986	60		34	94	36.2	94	1.000
1987	-		-	-	-	53	-
1988	-		-	-	-	31	-
1989	-		52	52	-	192	0.271
1990	16		47	63	74.6	213	0.296
1991	-		-	-	-	308	-
1992	-		-	-	-	314	-
1993	57	7	35	99	35.4	817	0.121
1994	7	0	20	27	74.1	154	0.175
1995	na	na	na	na	na	na	na
Mean,90-94	-	-	-	-	-	361	-
95+/- Mean	-	-	-	-	-	-	-

Table 2. Calculation of the spawning target for the Bouctouche River.

AREAS SURVEYED: Total habitat - sq.m (DNRE database):	
Bouctouche main (above forks)	295493
Bouctouche main (below forks)	82354
Upper North Branch	22377
Richard Brook	6706
Unnamed tributary	4900
Johnson Brook	20645
McLean Brook	9820
Yankee Brook	8420
South Branch	206134
Bailey Brook	4369
Total Area	661218

STOCK CHARACTERISTICS: (mean 1993-95)	
Male proportion of large salmon	0.24
Female proportion of large salmon	0.76
Mean length of large female salmon (cm)	78.1
Eggs per large female (1.4132 x LN(FL) + 2.7560)(Randall MS1985)	7441
Eggs per large salmon (eggs / lg female x lg female proportion)	5655
Male proportion of small salmon	0.85
Female proportion of small salmon	0.15
Mean length of small female salmon (cm)	55.6
Eggs per small female (3.1718 x LN(FL) - 4.5636)(Randall MS1985)	3573
Eggs per small salmon (eggs / sm female x sm female proportion)	536

SPAWNING REQUIREMENTS:	
Egg deposition rate (no. / sq.m) (CAFSAC MS1991)	2.4
EGG TARGET (millions) (Total area x deposition rate)	1.587
TOTAL LARGE SALMON (egg target / eggs per lg salmon)	281
Large females (total large x lg female proportion)	213
Large males (total large - large females)	67
Small males needed (large females - large males)	146
TOTAL SMALL SALMON (sm males needed / sm male proportion)	172

2SW COMPONENT:	
Proportion 2SW (of total large salmon: mean 1992-1994)	0.87
TOTAL 2SW (total large x proportion 2SW)	244

Table 3. Salmon catches by day and standard week in Bouctouche River estuary trapnets, 1995.

Date MoDa	Mark Large	Mark Small	Recap Large	Recap Small	Both Large	Both Small
918	1	1			1	1
919	0	0			0	0
920	0	1			0	1
921	0	0			0	0
922	0	0	0	1	0	1
923	0	0	0	2	0	2
924	0	0	0	0	0	0
925	0	0	0	1	0	1
926	0	0	0	0	0	0
927	0	0	0	1	0	1
928	2	2	0	0	2	2
929	0	3	2	1	2	4
930	0	0	1	0	1	0
1001	0	0	0	2	0	2
1002	0	1	1	0	1	1
1003	0	1	0	2	0	3
1004	0	2	7	0	7	2
1005	0	0	3	4	3	4
1006	0	0	0	0	0	0
1007	1	1	6	8	7	9
1008	0	0	2	1	2	1
1009	1	2	2	2	3	4
1010	1	0	1	1	2	1
1011	1	0	0	0	1	0
1012	1	0	1	0	2	0
1013	0	0	1	0	1	0
1014	0	0	3	3	3	3
1015	1	0	1	3	2	3
1016	0	0	1	0	1	0
1017	0	0	0	0	0	0
1018	1	0	2	0	3	0
1019	0	2	1	0	1	2
1020	0	0	0	0	0	0
1021	0	1	3	1	3	2
1022	0	0	0	0	0	0
1023	1	0	0	0	1	0
1024	0	0	0	0	0	0
1025	0	0	0	1	0	1
1026	0	0	0	0	0	0
1027	0	0	0	0	0	0
1028	0	0	0	0	0	0
1029	0	0	0	0	0	0

Std Week	Mark Large	Mark Small	Recap Large	Recap Small
38	1	2	0	2
39	3	5	3	5
40	1	5	16	16
41	4	3	9	6
42	2	3	7	4
43	1	0	0	1
44	0	0	0	0

Cumulative Total

Std Week	Mark Large	Mark Small	Recap Large	Recap Small
38	1	2	0	2
39	3	7	3	8
40	4	12	19	24
41	5	14	28	30
42	10	17	35	34
43	11	17	35	35
44	11	17	35	35

Standardized weeks used to describe run timing

Std Week	Month	Days
38	Sep	17-23
39	Sep	24-30
40	Oct	01-07
41	Oct	08-14
42	Oct	15-21
43	Oct	22-28
44	Oct	29-04

Table 4. Salmon catches by day and standard week at Bouctouche River counting fence, 1995.

Date MoDa	Large	Small
1011	0	3
1012	0	0
1013	0	4
1014	0	1
1015	0	1
1016	0	2
1017	0	1
1018	0	2
1019	0	0
1020	0	1
1021	0	1
1022	0	1
1023	0	3
1024	3	1
1025	1	2
1026	1	1
1027	0	0
1028	1	2
1029	0	0
1030	1	1
1031	2	0
1101	0	0
1102	0	0
1103	1	0
1104	0	0
1105	0	0
1106	0	0
1107	0	0
1108	0	0
1109	0	0

Std Week	Large	Small
41	0	8
42	0	8
43	6	10
44	4	1
45	0	0

Cumulative Total

Std Week	Large	Small
41	0	8
42	0	16
43	6	26
44	10	27
45	10	27

Standardized weeks used to describe run timing

Std Week	Month	Days
41	Oct	08-14
42	Oct	15-21
43	Oct	22-28
44	Oct	29-04
45	Nov	05-11

Table 5. Age distribution of Bouctouche River salmon, 1994. SW = sea winter; repeat spawner categories indicate total sea age followed by sea ages at which the fish spawned.

			Repeat Spawners					
Smolt Age	1SW	2SW	2.1	3.1	3.2	4.2	4.2.3	Total
2+	13	34	1	0	1	4	2	55
3+	17	11	1	1	3	0	0	33
4+	1	0	0	0	0	0	0	1
Total	31	45	2	1	4	4	2	89

Proportion repeat spawners of MSW = 22%
Proportion 2SW of MSW = 78%

Table 6. Densities and Percent Habitat Saturation (PHS) of juvenile Atlantic salmon at three locations on the Bouctouche River, 1995. Data provided by the Southeast Anglers Association.

			Area	No. per 100 sq.m			
Location	Site	Habitat	sq.m	0+	1+	2+	PHS
Bouctouche (main)	1	Run	1428	0.95	0	0	0.1
	2	Riffle	1290	2.59	0.89	*	0.7
Bouctouche (South Branch)	5	Run	882	0	1.21	*	0.4

Fork length measurements:
0+ = Fry: < 6.7 cm
1+ = Small Parr: 6.7 - 9.6 cm
2+ = Large Parr: > 9.6 cm

* Not calculable; PHS calculated without 2+ density

Figure 1. Fisheries Statistical Districts in Atlantic Canada.

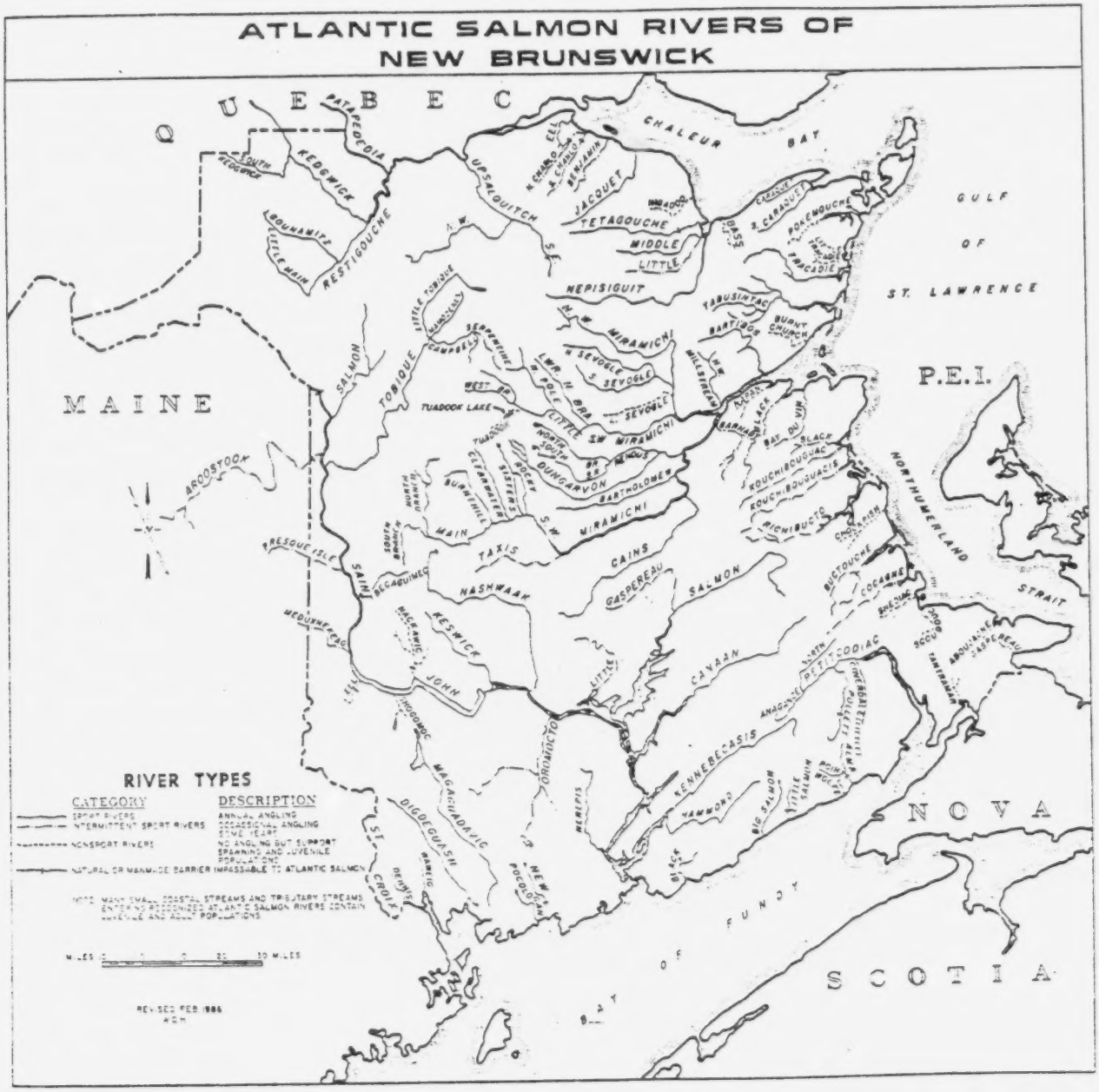

Figure 2. Atlantic salmon angling rivers of New Brunswick. (Map prepared by DNRE)

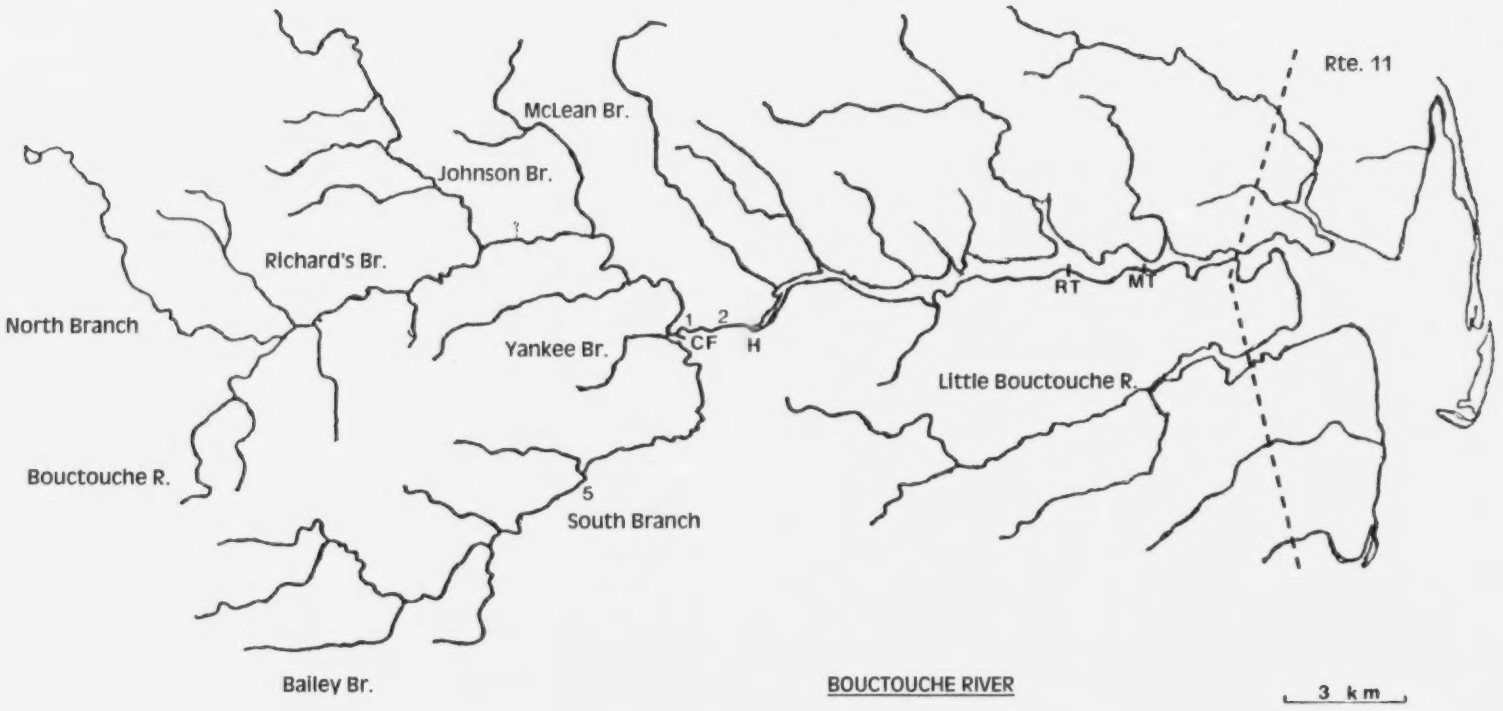

Figure 3. Location of traps, counting fence and electroseining sites on the Bouctouche River, 1995. **MT** - Mark Trap; **RT** - Recapture Trap; **H** - Head of tide; **CF** - Counting Fence; **1,2,5,** - Electroseining sites.

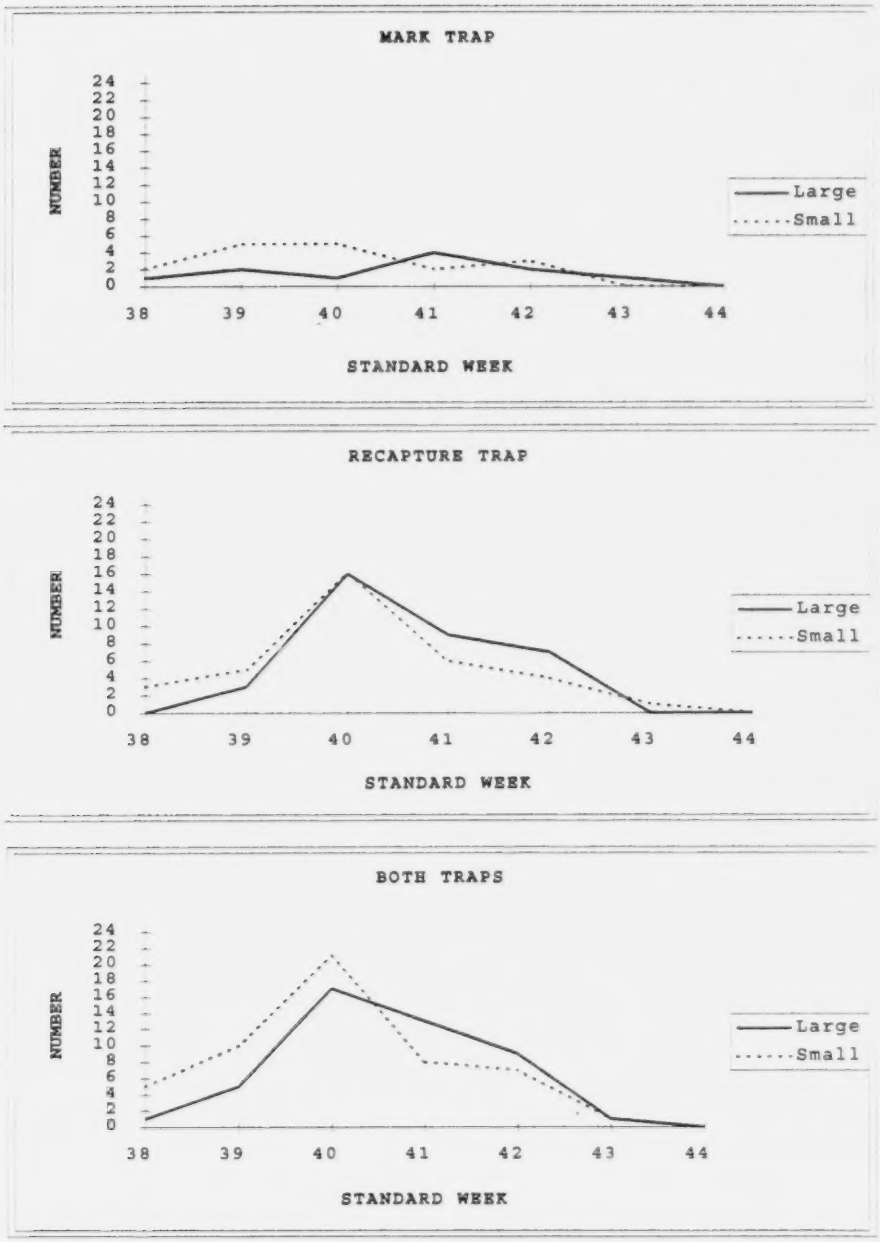

Figure 4. Catches of large and small salmon at Bouctouche River estuary traps, 1995. Standard weeks are described in Table 3.

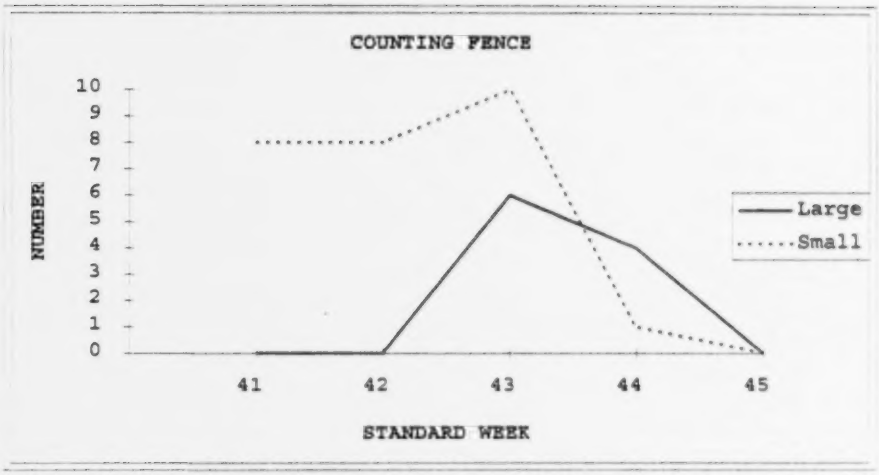

Figure 5. Catch of large and small salmon at Bouctouche River counting fence, 1995. Standard weeks are described in Table 4.

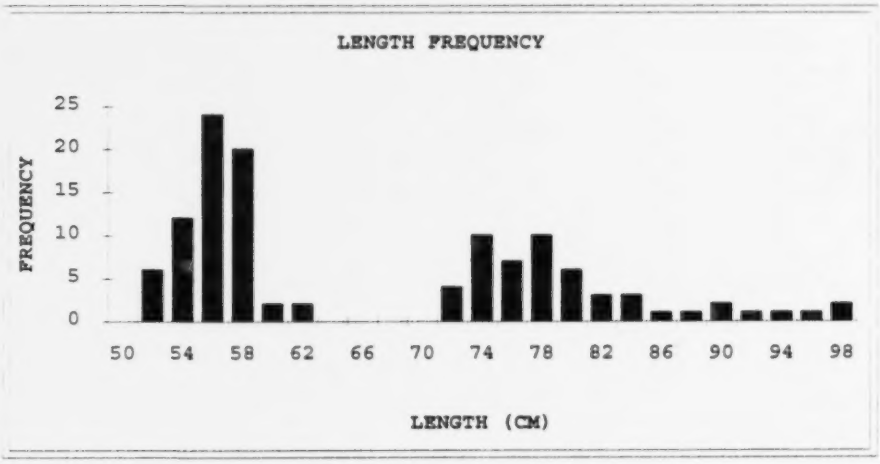

Figure 6. Length frequency of salmon caught in Bouctouche River traps, 1995. Recaptures have been excluded.

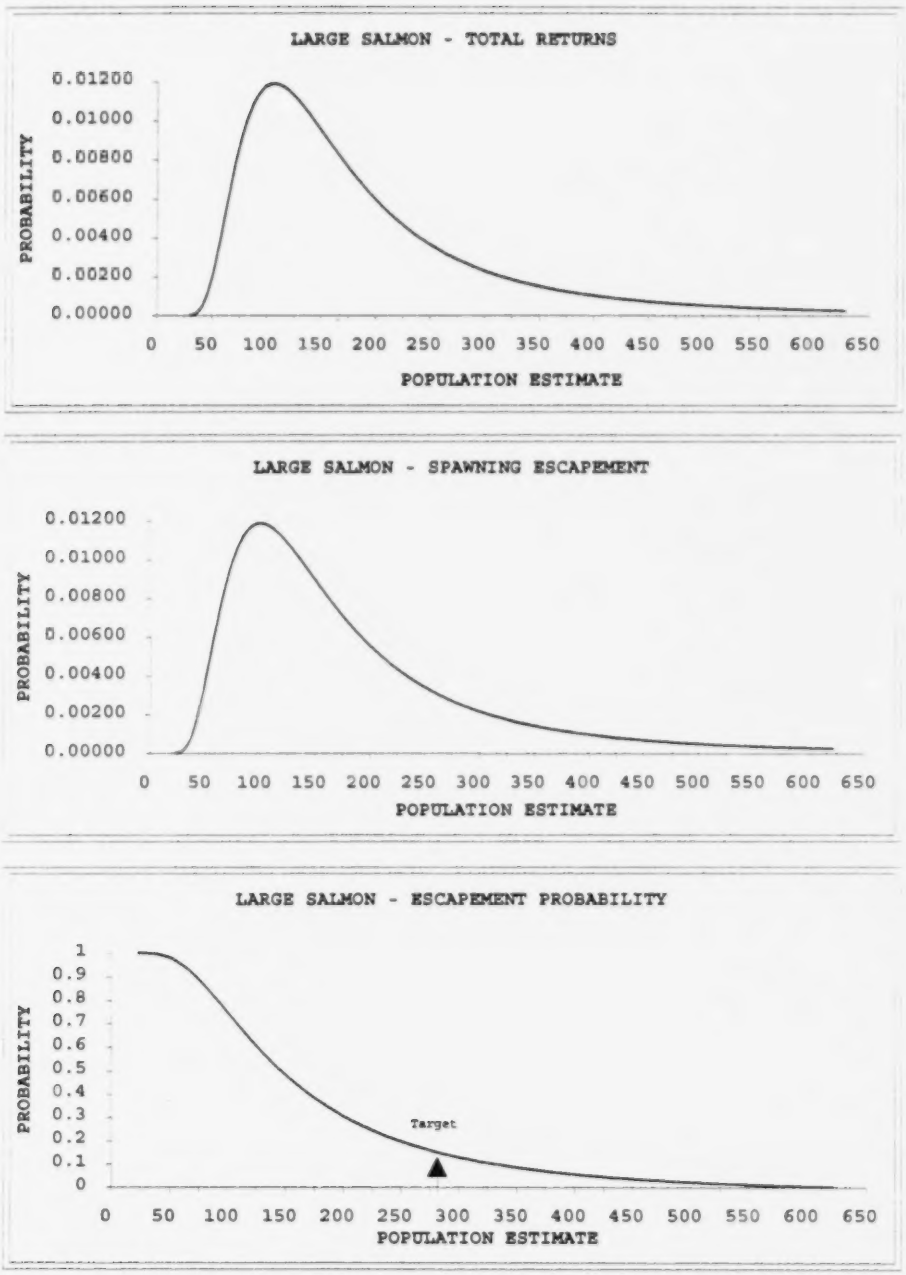

Figure 7. Estimates of large salmon total returns (108), spawning escapement (101) and probability (0.15) of achieving target spawning escapement (281) for the Bouctouche River in 1995, calculated from upper estuary trap recaptures.

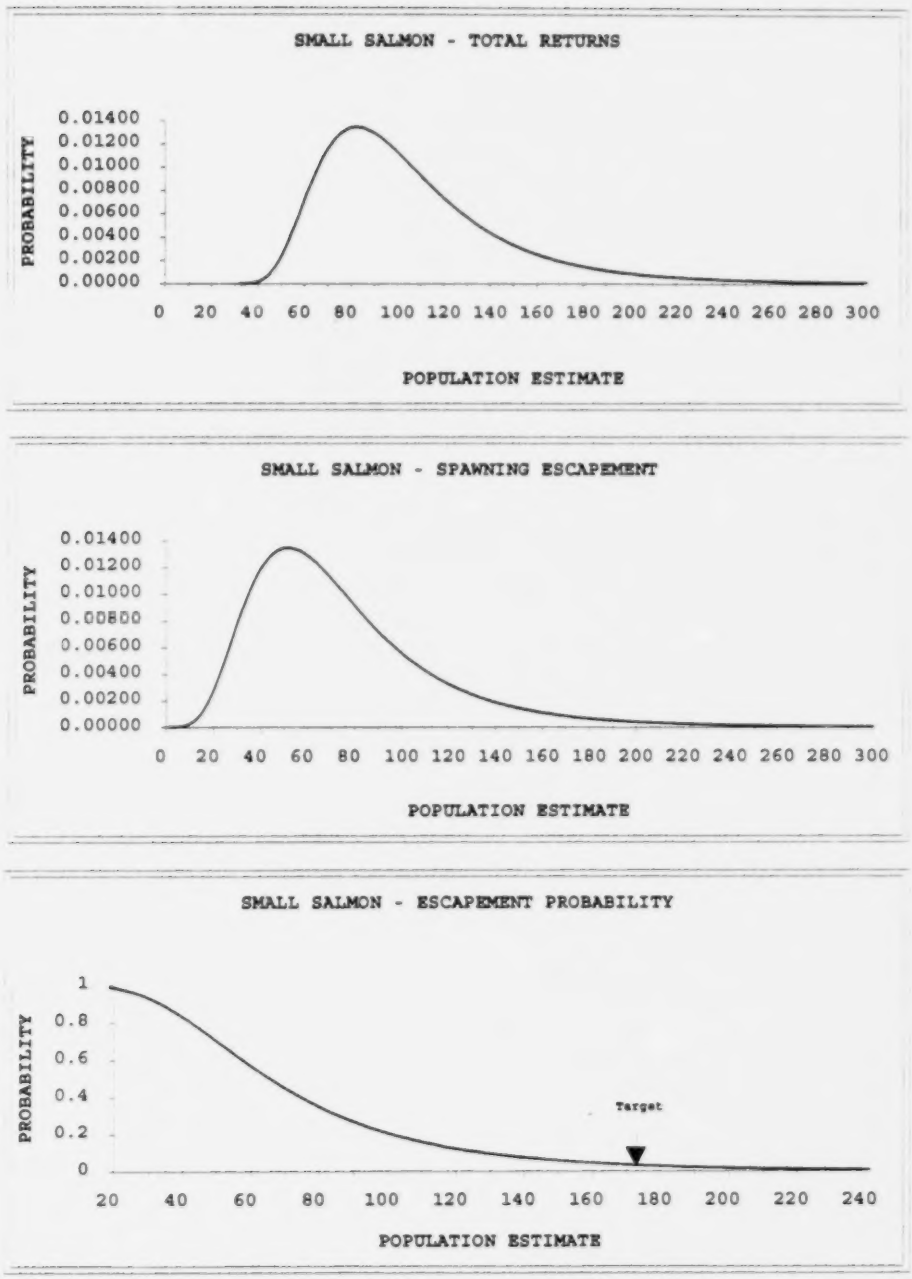

Figure 8. Estimates of small salmon total returns (83), spawning escapement (52) and probability (0.03) of achieving target spawning escapement (172) for the Bouctouche River in 1995, calculated from upper estuary trap recaptures.

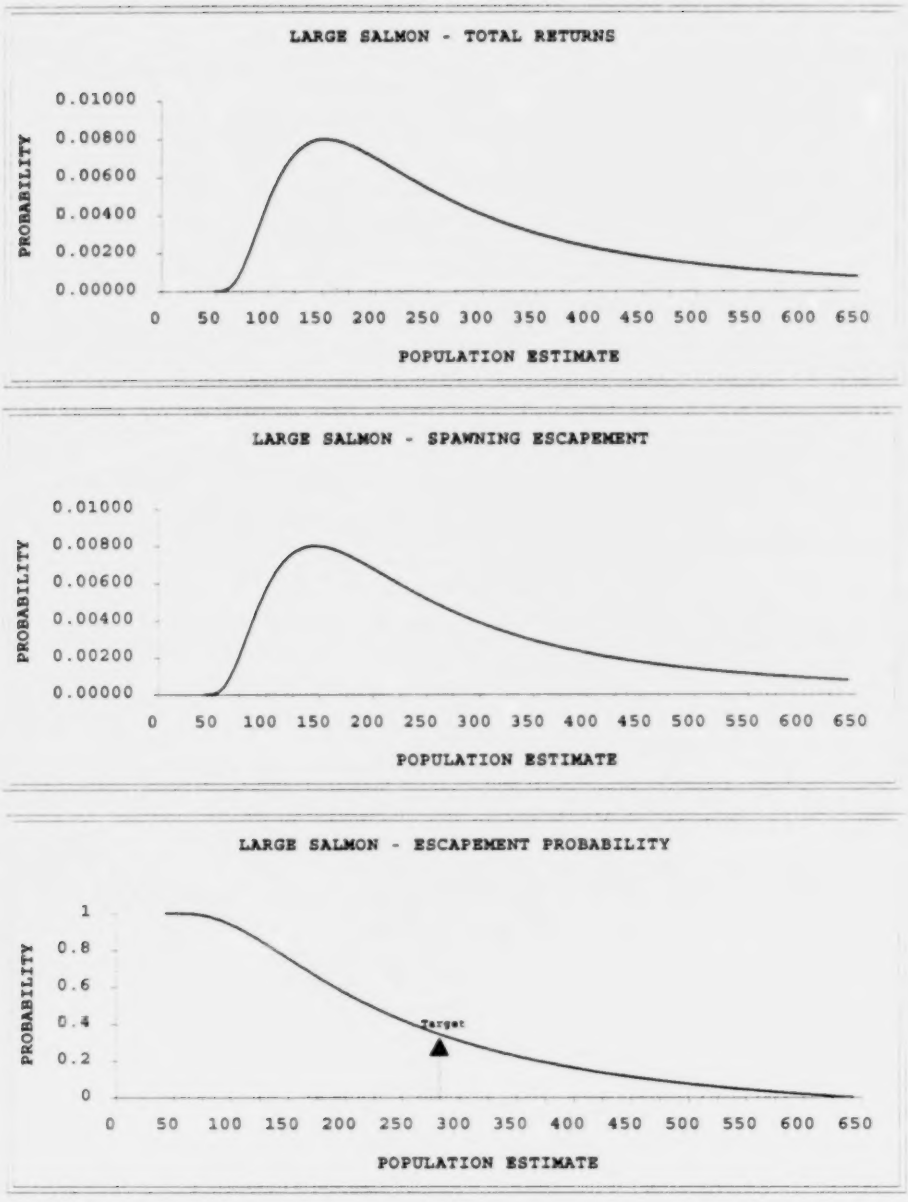

Figure 9. Estimates of large salmon total returns (154), spawning escapement (147) and probability (0.35) of achieving target spawning escapement (281) for the Bouctouche River in 1995, calculated from counting fence recaptures.

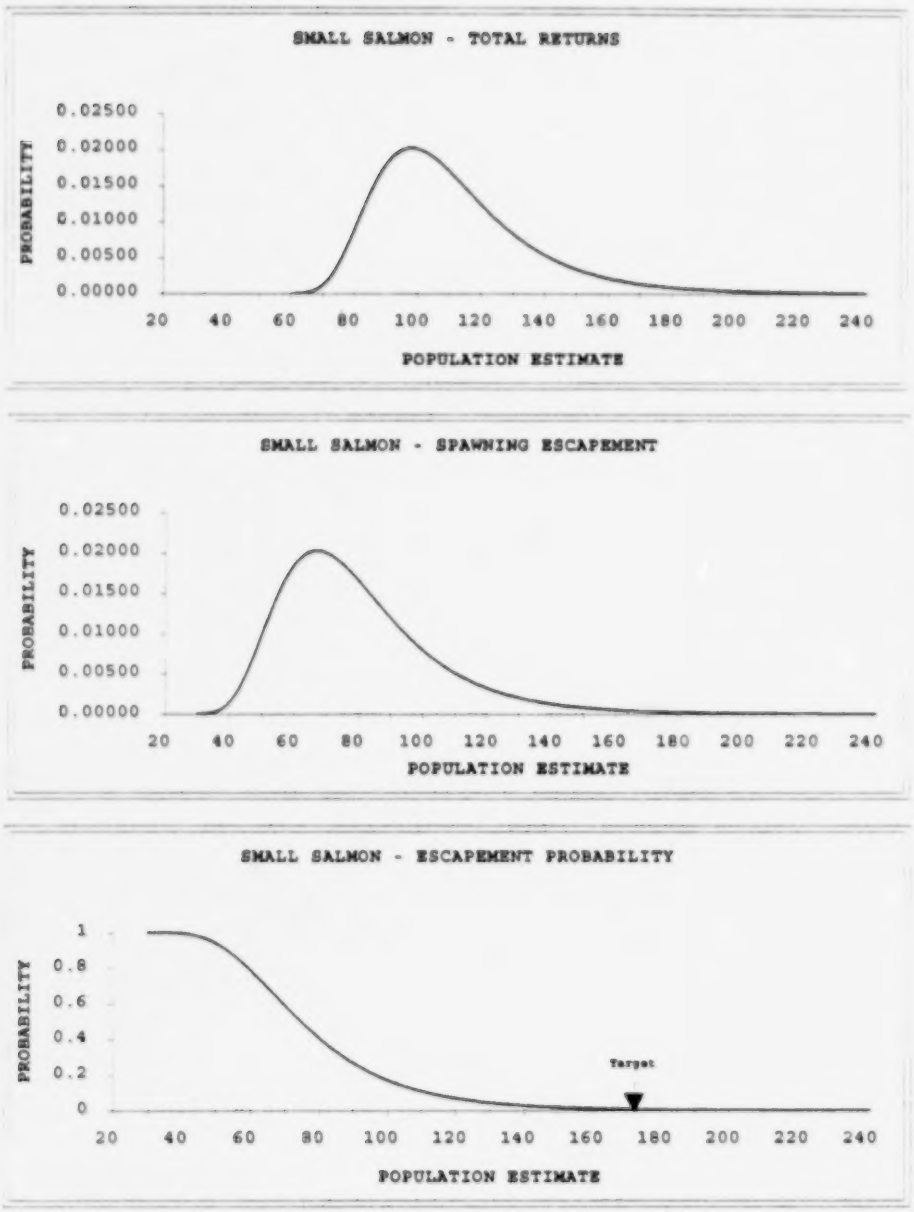

Figure 10. Estimates of small salmon total returns (98), spawning escapement (67) and probability (0.006) of achieving target spawning escapement (172) for the Bouctouche River in 1995, calculated from counting fence recaptures.

Appendix 1.

NOTES FROM THE BOUCTOUCHE SALMON SCIENCE WORKSHOP

Band Office, Buctouche First Nation
0900 - 1200 Hours, Wednesday, 6 December 1995

Attendees:

Bill Sanipass	Chief, Buctouche First Nation
Marie-Josée Maillet	Southeast Anglers Association
Gérald Chaput	DFO Science, Moncton
Gary Atkinson	DFO Science, Moncton

General comments

A spawning run of Atlantic salmon enters the Bouctouche River during September and October, and is exploited for food by Buctouche First Nation and for public recreational angling. Information on stock status is required to manage salmon harvest on the Bouctouche, ensuring that adequate spawning escapement occurs on a sustainable basis.

The meeting was convened to present and discuss the results of research efforts and the co-operative salmon stock assessment project carried out on the Bouctouche River in 1995 by DFO, Buctouche First Nation, and the Southeast Anglers Association. The meeting was less well attended than expected, as Tom Pettigrew from the New Brunswick Department of Natural Resources and Energy, Jean-Claude Babineau from the Southeast Anglers Association, and Rhéal LeBlanc from the Kent County Anglers Association had other commitments and were unable to attend. Consequently, a clear direction for future work did not emerge from the meeting, and it was decided to reconvene at a future date to discuss this.

Gary Atkinson presented the data directly relevant to the co-operative stock assessment effort with Buctouche First Nation and the Southeast Anglers Association; Marie-Josée Maillet presented

the results of electrofishing and by-catch surveys conducted by the angling association.

Fisheries

First Nation

Buctouche First Nation currently harvests salmon from research trapnets in the Bouctouche River during September and October. In 1995 15 small salmon were removed for food. Allocations to Buctouche First Nation under the AFS agreement in 1995 were 36 large and 56 small salmon.

Recreational

Recreational angling occurs from the head of tide upstream, principally during the month of October: there is no leased water on the system. There is no accurate estimate of angling catch, but a telephone survey of 27 anglers known to fish the Bouctouche River indicated that at least 8 small salmon were retained and 2 were released: no large salmon were caught and released. It is not known what proportion of all angling the survey represents.

Poaching

Fishery officers (DFO, DNRE) estimate that 6 large and 24 small salmon were taken from estuary smelt traps, and 20 large fish were removed by various means in freshwater. A survey of by-catch in the Bouctouche estuary from gaspareau traps (June), and smelt traps (November), conducted by the Southeast Anglers Association found no incidence of salmon. Poaching is considered to be a serious problem on this river but documentation is poor because apprehensions are infrequent.

Broodstock

Seven large and 8 small salmon were taken for reproductive products and subsequently returned to the river, as an enhancement initiative of the Southeast Anglers Association.

Target

The spawning target for the Bouctouche River is 1.587 million eggs. This is based on an optimum deposition rate of 2.4 eggs per square meter, and the area of wetted habitat as measured by DNRE. Using stock characteristics observed in the current year, the egg target represents 268 large and 189 small salmon.

Data

Mark-Recapture

Blue Carlin tags were attached to all salmon caught and released in two estuary traps which operated from 18 September to 29 October. Tags were recovered at the upper trap, a counting fence which operated upriver from 11 October to 10 November, and from angling captures above the fence. Tagging effort and recaptures may be summarised as follows:

Tags Applied

Location	Large	Small
Marking trap	11	15
Recapture trap	35	22
Total	46	37

Tags Recaptured

	Large		Small	
Location	Recap	Catch	Recap	Catch
Recapture trap	4	39	8	43
Counting fence	3	10	12	27
Angling	0	0	7	10

Total catch for both estuary traps was 46 large and 53 small salmon. Run timing appeared to be several weeks earlier than 1994. The operation of the counting fence was problematical in the high water conditions of 1995, and was only partially

operating much of the time. Total catch was only 10 large and 27 small salmon. Although a complete count was not possible it served as a tag recapture site and was seen as a valuable component of the assessment program and one that should be continued, funds permitting.

Age determination

The 1995 sample has not yet been aged: of known-age fish in 1994, 2+, 3+, and 4+ smolts respectively comprised 62%, 37% and 1% of the sample. Of the multi-sea-winter (MSW) component, 78% were maiden two-sea-winter (2SW) fish and 22% were repeat spawners. Of the total number of repeat spawners, 23% had previously spawned as a one-sea-winter (1SW) fish, or grilse.

Juvenile surveys

Data was presented from three sites which indicated very low densities of all age classes at all sites. It was generally considered that a great deal more effort was needed and justified to provide an adequate indication of juvenile densities in the Bouctouche system.

Spawner surveys

A survey was attempted from the Forks to the head of tide (2 km) but due to high discoloured water was not successful. It was generally felt that conditions in the fall are not conducive to meaningful counts.

Status

Methods

Returns were calculated in two ways: 1) from tags placed in the lower estuary trap and recovered in the upper, and 2) from all tags placed at estuary traps and recovered at the counting fence. The most probable population size given R recaptures out of M marks placed in a sampled catch of C was calculated over a range of possible population sizes using a Bayesian estimator. Total returns to the system were obtained by adding known or estimated removals to the marking site, then the corresponding spawning

escapement was computed by subtracting total removals from total returns.

Calculated from upper estuary trap recaptures, total large salmon returns were 114 with a spawning escapement of 81. Small salmon total returns were 107 with a spawning escapement of 52.

Calculated from counting fence recaptures of all tags, total returns of large salmon were 160 with a spawning escapement of 127. Small salmon total returns were 122 with a spawning escapement of 67.

Target met

Assuming that all fish spawned, the two estimates of returns indicate that only between 32% and 50% of the egg target was met for the Bouctouche River in 1995.

Trends

Target egg deposition has not been met on the Bouctouche River for the three years for which the stock has been assessed (1993-95). Deposition in 1995 was at least 11% lower than in 1994.

Ecology

High water for an extended period after mid October was probably beneficial to spawners, allowing them better access to upriver spawning sites than in 1994, and potentially deterring poaching efforts.

Prospects

At present there is no reliable method of forecasting returns of Atlantic salmon to the Bouctouche River. It may be possible to develop in-season forecasting using run-timing to the trapnets when a sufficient number of years of trapnet operation have accumulated. Given a longer term data set, it may be possible to develop a stock/recruit relationship. Increased returns in 1994 over the previous year seemed to indicate a potential for recovery, but this was not sustained in 1995.

Other

A meeting of all parties concerned with assessment, enhancement and conservation on the Bouctouche River will be held at a later date to further discuss improvements and priorities in future work.